NELANT DATA ASSESSMENT

APPENDIX III - MODELING REPORT

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14 SAI-78-527-WA

11 25 Feb[redacted]77

12 29p.

408 404

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Prepared under contract No. 15 N00014-76-C-0488

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SUMMARY

This Appendix attempts to consolidate needs across the four systems as expressed by the System Principal Investigators (S. Marshall (NRL) for SURTASS/SASS; D. Young (USI) for Fixed Bottom Arrays; R. Kirklin (Tracor) for Distributed Near Bottom Sensors; and L. Solomon (PSI) for Short Towed Arrays). Anticipating the enormity of a full-fledged assessment the emphasis has been on unifying the approaches, and in some instances recommendations have been suggested in addition to, or in place of the PIs preference. In doing so, a degree of internal consistency has been sought, occasionally at the expense of parochial interests.

The modeling requirements are summarized below:

- Beamed Systems (NRL, USI, PSI) - Long-range transmission-loss predictions in a range-dependent environment are required plus, for short towed arrays, high-frequency short-range losses and shallow-water losses. Modeled beam-noise levels reflecting the azimuthal anisotropy and temporal variability of the noise field including distributions and temporal correlation properties are required, while the levels of detail recommended by the System PIs vary. Consistency here appears to be warranted.

- Distributed Near-Bottom Sensors (Tracor) - Predictions of short-range deep-water transmission loss in a range-independent environment and shallow-water transmission loss over gradual slopes are required. A model is required capable of predicting the near-bottom variations of noise with depth and location.

These acoustic requirements lead to supporting environmental data requirements for processed, extrapolated, gridded, and retrievable environmental inputs which are compatible with the acoustic models and ready for direct access by the models.

A number of deficiencies have been identified in assessing the present capability to meet these overall requirements:

- The recommended transmission-loss model (a combination of the parabolic-equation and multiple-profile-program models) has been formulated but not yet developed.

- A plethora of beam-noise models has been proposed, all different in detail though the same in principle, none adequate for everyone's needs.

- The required near-bottom noise model does not exist, nor is it even formulated. While it probably can be developed there will be no appropriate NELANT data with which it can be evaluated.

- While the environmental data base has been judged adequate to proceed with on assessment, it is by no means ready to support the assessment in the way indicated above. Environmental "models" for neither the sound-speed structure nor the bottom reflectivity have been developed, and an internally consistent shipping-density model is lacking.

Assuming that an assessment is to procede for each system, the following major future efforts are required in the modeling area to support the assessment.

- The PE/MPP transmission loss model must be developed.

- If the individual PI's approaches to beam-noise modeling are to be approved (along with the resulting inconsistencies in approach) minor efforts are required for NRL and USI. PSI did not propose a specific approach for beam-noise fluctuations on the short towed arrays, however, the effort there would be more substantial

- If a consolidated approach is desired, a single beam-noise fluctuation model must be constructed using detailed shipping, range- and bearing-dependent transmission loss, and a statistical analysis package which treats second- as well as first-order statistics.

- The near-bottom noise model must be developed encompassing the integrated, area-wide joint effects of bathymetry, reflectivity, sound-speed structure, and shipping.

- Synoptic sound-speed sections for the summer must be selected, extrapolated, extended to the winter and prepared for input to PE/MPP.

- The bottom reflectivity data must be interpreted, extrapolated, gridded and banked in a data base interfaced with PE/MPP.

- The SQUARE DEAL shipping observations must be assimilated in (or rationally reconciled with) the RMS distributions.

Finally, it is recommended that the efforts be consolidated as much as possible; that sites common to more than one system be considered; and that intermediate output be stored in a computer-readable format for re-processing and display. This will require an additional effort to automate the job stream in the context of a user-oriented, responsive system.

A. MODEL REQUIREMENTS

This section summarizes the requirements for predictive acoustic models as determined by the System Principal Investigators, or where not specifically stated by the Systems PI, as recommended by the Modeling Consultant. The resulting requirements for supporting environmental data to be used as input to the acoustic models are also summarized by system.

For transmission loss the systems require three basically different types of models: one capable of treating a fully range-dependent environment (sound-speed, bathymetry, and reflectivity), one able to treat a range-independent, deep-water environment, and one able to treat a shallow-water environment with modest range-dependence such as a gradual slope. In some instances a gross range average (over distances comparable to convergence zone (CZ) spacings) is adequate, while in others the transmission-loss curve must contain at least the CZ structure and possibly representative multipath-interference effects.

Ambient-noise omni levels as well as both azimuthal and vertical directionality are required. Also in some instances the distribution functions for noise fluctuations and second-order statistics such as the temporal correlation properties are required.

Corresponding environmental input data encompass sound-speed, bathymetry and reflectivity both at discrete positions and along selected tracks. Certain area-wide characteristics of bathymetry may also be required such as the distribution of depths about a point, or the minimum depth as a function of azimuth in the first hundred miles from a specific location. Shipping information may be required in the form of both densities and discrete several-hour realizations of ship traffic. Wind-speed estimates for specific areas are also required.

The requirements for these forms of data are summarized by system in Table III-1. An (x) indicates the System PI's recommendation and a (✓) indicates the Modeling Consultant's recommendation where either the System PI failed to address the issue or where the Modeling Consultant felt strongly that such a requirement should be considered. The first two footnotes indicate data sets which the System PI proposed as alternatives to modeled results if the models were either unavailable or failed to compare favorably with measured data. It must be noted that two of the four sites NRL proposed for backup (SQAURE DEAL Site 2BB, and NEAT I CHAIN Site 2A) have suspect acoustic data which will not "validate" against the acoustic models, perhaps for good reason. Site 2BB is also inappropriate for SURTASS since it is in shallow water over a steep slope.

The additional footnotes summarize the Modeling Consultant's rationale for suggesting additional requirements. Specifically

(3) The upper frequencies in the short towed array's operating range will be most important at ranges of 100 miles or less where representative environments are reasonably

Requirements	Type/Resolution	Bottomed Arrays	Short Towed Arrays	Long Towed Arrays/SASS	Distributed Near-Bottom
Transmission Loss	Range Dependent	X(1)	X	X(2)	
	Independent		✓(3)		X
	Shallow Water		✓(4)		X
	Range Averaged			X	
	Details Thru CZs	X	X	X	X
Ambient Noise	Omni-Directional				X
	Azimuthal Directionality	X(1)	X	X	
	Vertical Directionality				X
	Distributions	✓(5)	X	X	X
	Temporal Correlation	✓(6)	X	✓(6)	X
Supporting Environmental Data	Sound-Speed Profiles				
	Discrete Positions		✓(3,4)		X
	Along Tracks	X	X	X	
	Bathymetry				
	Discrete Positions		✓(3,4)		X
	Along Tracks	X	X	X	
	Area Characteristics				X
	Reflectivity				
	Discrete Positions		✓(3,4)		X
	Along Tracks	X	X	X	
	Wind Speed		✓(3,4)		X
	Shipping				
	Densities	X	X	X	X
	Traffic	✓(5)	X	X	X

Key:

X - Recommended by System PI
✓ - Not specified by System PI, but recommended by Modeling Consultant

Notes:

(1) Data Alternatives - VECO and NEAT II
(2) Data Alternatives - SQUARE DEAL and NEAT I
(3) Ranges for high frequencies short enough for range-independent model
(4) Towed Arrays are only mobile alternative to Distributed Systems in Shallow Water and Assessment may be required
(5) Atypical traffic may result in substantially different distributions from standard treatments
(6) Atypical traffic also may lead to different decorrelation times

Table III-1. Model Requirements

range-independent. Also, at these frequencies wind noise may dominate shipping noise leading to the wind-speed requirement.

(4) The short towed-array is the only likely alternative to a distributed field in the shallow-water areas. While a number of uncertainties will arise (not the least of which is array signal gain in such an environment) the trade-off against distributed systems as a function of signal-gain degradation may be a likely study attempted by users of the assessment.

(5) For bottomed arrays there is no requirement for the distribution of beam noise. Goldman (BTL) has shown comparisons of predicted and observed beam-noise fluctuation distributions from the NELANT area which indicate good agreement (they are modelable) and substantially different variances on different beams of the same array (that is, the modelable differences are significant).

(6) Just as the unusual traffic characteristics in NELANT may lead to atypical distributions, traditional views of decorrelation times of beam noise may be inappropriate. While NRL is willing to use the mechanism of ships moving through the beam to generate beam-noise fluctuation distributions, they are unwilling to make the consistent extrapolation to the second-order (correlation)

statistics since the LAMBDA data base could not provide such measures. Goldman has also compared predicted and observed beam-noise decorrelation times and found them consistent with the shipping model.

While most of the modeling requirements are fairly standard (though not necessarily easy to meet, as discussed subsequently) a more complete description of the noise model required for distributed near-bottom systems is appropriate at this point. Basically, the model must be able to reflect the effects of irregular bathymetry and variable bottom loss, integrated over neighborhoods surrounding potential sensor locations. In areas of poor reflectivity and sparse shipping the noise has been observed to decrease markedly near, but above the bottom. The depth at which such a decrease occurs (if it occurs at all in a particular location) is an important parameter. In NELANT, where some very good reflectivity and some very high shipping densities have been found, the possibility for such noise decreases is an open question, and the area's complex bathymetry may be the determining factor.

At present there is no model capable of predicting this feature of the ambient noise. Such a model, if developed, would have to include the joint effects of bathymetry, reflectivity, sound-speed structure, and shipping characteristics, integrated over large areas. It might also be obliged to include diffraction effects such as mode stripping and leakage. It is likely that such a model would be tied at specific locations and depths to measured noise values (and hence be "semi-empirical" as suggested by Tracor). If such a model were developed and successfully evaluated against appropriate measurements from CHURCH ANCHOR and CHURCH OPAL, a valid extrapolation to NELANT could neither be presumed nor spot-checked since there are no appropriate NELANT data.

Of all the model requirements this is the most difficult to meet in terms of development, and its credibility in NELANT will be the hardest to establish.

B. MODELS TO BE USED AND DESCRIPTIONS

The System PIs each recommended models to use for transmission loss and noise. The "model" for the environment to be used as input to the acoustic models was only partially addressed and is discussed in detail later in this section.

Acoustic Models

The relatively consistent treatment of propagation loss across the systems is contrasted to the apparently diverse treatments of noise as shown in Table III-2 below.

Requirement	Model	System: Bottomed Arrays	System: Short Towed Arrays	System: Long Towed Arrays/SASS	System: Distributed Near Bottom
Transmission Loss					
	PE Combined With MPP	X	X	X	
	FACT		✓		X
	SHALFACT		✓		X
Ambient Noise					
Transmission Loss From Above Plus					
	FANM ships	X			
	TASSRAP		X		
	SIAM			X	
	DSM		X		
	USI/DSM/SAI	✓	✓	✓	
	Omni - PL				X
Near-Bottom Noise Model (NBNM)					X
FANM (Plus Tracor Wind Noise)					X

X - System PE Recommendation
✓ - Modeling Consultant Additional Recommendation

Table III-2. Recommended Models to be Used

Detailed descriptions of these models may be found elsewhere; this discussion emphasizes their similarities and differences to support the recommended approaches.

For transmission loss in a range-dependent environment the System PIs (with strong coaxing from the Modeling Consultant) unanimously opted for a combination of the Parabolic-Equation (PE) Model for waterborne paths with the Multiple Profile Program (MPP) for bottom interacting paths. This combination would work for frequencies as high as 300 Hz, however, an extrapolation technique for PE from (say) 100 to 300 Hz would be highly desirable. For range-independent environments FACT would be used in deep water and a mode-like shallow-water extension (SHALFACT) in shallow water.

For the beamed, horizontal array systems the noise-modeling questions concern average directionality versus the statistics of beam noise. All System PI's recommend combining propagation loss appropriate to surface ships obtained from the above models with shipping fields based upon the existing RMS (Ross - Mahler - Solomon) densities, augmented by the SQUARE DEAL observations. (PSI dissents on this last point for reasons too sophisticated for this investigator to appreciate.) For bottomed arrays the ship densities would be extracted in range-bearing sectors by the automatic ship extraction portion of the Fast Ambient Noise Model (FANM). These would be combined with appropriate source levels and the predicted losses to produce the azimuthal noise field for subsequent convolution with the array beam patterns.

For short towed arrays a similar approach would be followed using the TASSRAP driver tailored to the NEPAC regional assessment. While this driver is highly system oriented it has the desirable feature of being able to rotate the array through a number of possible headings, computing the corresponding beam noise, and then summarizing various key results.

For beam-noise fluctuation modeling, NRL selected their Simulation of Ambient Noise Model (SIAM), PSI its Discrete Shipping Model (DSM) in combination with unspecified statistical-analysis and noise-summation packages, and USI hoped that beam-noise fluctuation modeling would not be necessary. The distributed near-bottom sensors would model noise fluctuations from nearby shipping with an omni-directional noise-fluctuation model - Omni-PL. This interference field would be superimposed on a background constructed using either the near-bottom noise model (NBNM) discussed previously for deep water or FANM (modified to incorporate TRACOR's CHURCH OPAL wind-noise source levels) for shallow water.

The diverse treatments being proposed for beam-noise fluctuation modeling raise several issues concerning internal consistency of the assessment across systems. A number of other models are also available:

- NORDA's Beam-PL Model
- GRC's (now NORDA's) Beam Noise Model
- SAI's Discrete Shipping Beam Noise Model
- USI's Beam Noise Distribution Model

With the exception of USI's model, all of the beam-noise models are, in principle, similar: discrete realizations of shipping traffic are generated; the ships (with appropriate source levels) couple to the receiver via the propagation loss and beam response in their direction; a time series (or set of time series) of beam noise is generated and analyzed for its statistical properties. These Monte Carlo Models all have certain limitations, however. SIAM can only analyze first-order statistics (distributions) because it makes certain assumptions about the fluctuations in propagation loss which would render second order statistics (such as the decorrelation time) meaningless. The DSM probably represents the most complete description of the shipping environment with the ability to generate realistic, relatively long, time series of ship tracks, but must be coupled to a noise summation and analysis package. Beam-PL has its own track generator, similar to DSM but not tied to specific geographic areas, a time series analysis package which addresses second- as well as first-order statistics but it treats only one beam at a time without minor-lobe contributions. GRC's model contains implicitely a FACT-like propagation-loss module which could only be circumvented with considerable effort. SAI's model is probably the most complete of the Monte Carlo simulation approaches since it has an extensive statistical analysis package which treats second-order effects (temporal correlation and beam-to-beam correlations) and since it includes detailed propagation loss(no random-process assumptions as in SIAM) and multiple beams with minor-lobe structure. It does require area-wide shipping-lone specifications similar to the parameters contained in DSM.

The USI model, unlike the others, is an analytical approach to computing the distribution function of beam noise. While it is not able to compute second-order statistics it is faster than the Monte Carlo models, and able to compute the distribution "tails" with higher precision.

It is the Modeling Consultant's recommendation that in order to guarantee consistent results through second-order statistics, a unified approach for the beamed systems be adopted as follows:

- Use the USI model to "size" a specific problem in terms of the spacial regions which drive the mean low-noise levels versus the fluctuations, and to compute beam-noise distribution functions;

- Use DSM-generated ship tracks over these regions as input to the SAI model to compute time series of beam noise and their statistical properties. (If a number of array headings and beamwidths are to be considered at a single location, the high-resolution noise power as a function of azimuth and time might be saved by the computer for subsequent convolution with various beam patterns.) The USI-computed noise distributions could be compared with the simulated distribution to ensure an adequate number of Monte Carlo replications.

Environmental "Models"

In assessing the feasibility of performing an area assessment the System PIs addressed the adequacy of the supporting environmental data base without suggesting which data should be used or how they should be processed. This is the practical problem of developing representative environmental sections along a number of bearings of interest and then interfacing these sections with the acoustic model (PE + MPP) in an automated way.

For sound-speed structure, while there are abundant summer data, the complex oceanography of the NELANT region argues strongly for using (nearly) concurrent observations (that is, synoptic data) rather than profiles along a track gathered in the same season or month of different years. The three SQUARE DEAL baselines have such synoptic sections which have already been prepared for PE + MPP (specifically prepared for CFIELD, the interface between sound-speed sections and PE + MPP). This interface preparation is a major bottleneck in current exercising of PE. Oceanographically guided projections of these baselines throughout their respective basins should provide a reasonable description of the summer sound-speed environment in the SQUARE DEAL area.

Similar (though sparser) sections were acquired by NOO in support of PME-124 in the southern portions of the NELANT area in 1972/73 as well as some sections from NEAT II and a number of oceanographic cruises. Once CFIELDed, select sections should then be "winterized" on a profile-by-profile basis by a physical oceanographer. While in the opinion of NRL these are not adequate winte oceanographic data to support a winter assessment, such an extrapolation should be feasible and the resulting acoustic uncertainity may be much less than the apparent oceanographic uncertainties.

For systems requiring profiles at discrete locations, the baseline profiles should be used except in shallow waters, where available single profiles might be more appropriate. Also, the significance of local variability could be addressed using the more extensive data since the interface issue is not a problem for the single-profile models.

For bathymetry, the BNC's were judged adequate and in one instance a major effort of transferring data to BC's and thence regional (NAR) charts was proposed. None of the PIs showed any interest in using the Synthetic Bathymetric Profiling System (SYNBAPS) which retrieves bottom profiles along specified tracks with a BNC-resolution in a fully automated mode. It is assumed that this was an error of omission and wherever profiles are needed SYNBAPS will be used. It may also be useful for generating bathymetry statistics for the near-bottom noise model once that model is defined.

While a number of bottom-loss measurements have been identified there still appears to be very little information on losses in the Icelandic Basin or on the Eastern flanks of the Mid-Atlantic Ridge. Nevertheless, assumming the present data base were adequate, the data must be assembled and extrapolated to an area-wide reflectivity chart for gridding and banking in a computer-accessible base. The interpretation and digestion of these data is a major task. In the course of extrapolating results to non-surveyed areas, major gaps may be identified which may only be filled by interpreting long-range transmission-loss measurements to infer a reflectivity.

The necessary wind speed data are available from atlases or from the NORDA 5-degree square bank. Shipping data have already been discussed, with the recommended densities being a combination of RMS densities with SQUARE DEAL observations.

C. MODEL LIMITATIONS

Extensive comparisons of PE with SQUARE DEAL, EASTLANT, PARKA, CHURCH ANCHOR, and other data sets indicate that for waterborne paths PE is as good as its environmental inputs, and when given good inputs has a residual error which is too small to distinguish from measurement error. MPP, while less accurate for waterborne paths, will only be used for bottom-bounce paths where it will be as accurate as its bottom-reflectivity inputs. The combined model will be input limited in accuracy.

At high frequencies (~300Hz) PE may be quite expensive to run, and approximate extrapolation from ~100Hz of the waterborne energy should be considered. The error introduced by such an extrapolation may be justified in terms of reduced computer time. Running time will impose a practical limitation on the number of parameter combinations which can be considered. A consolidation of runs for several systems (or at least the towed-array systems) may be warranted if mutually interesting sites can be selected.

FACT was evaluated against short-range SQUARE DEAL data in Rockall Trough and yielded good agreement given the proper reflectivity. It does have some difficulty with the double-minimum profile and should be checked on select cases against PE when problems are likely.

SHALFACT has been evaluated against limited shallow-water data with some success. Uncertainties in bottom-reflectivity drive the answer, and a sensitivity analysis is suggested to indicate propagation-loss bounds associated with bottom-loss bounds. Where marginal ducts are prevalent, cross-checks of SHALFACT with PE are recommended.

The limitations of the various beam-noise fluctuation models have already been discussed. The accuracy of such predictions (assuming good propagation-loss inputs) will be driven by the uncertainties in surface-ship densities and radiated source levels. Since much of the NELANT area has an extremely low-loss bottom at low frequencies, the uncertainty in vertical directionality of the radiated levels may be unusually important. It is suggested that the densities and source levels be "tuned" within reasonable limits to obtain agreement with the measured omni-levels from SQUARE DEAL at select sites.

The near-bottom noise model (if developed) will certainly be limited in credibility since there will be no NELANT data for comparison in the critical deep-water areas.

It should be re-emphasized that the recommended suite of models resulted from consideration of all available (or potentially derivable) models and rejection of a number of them on accuracy grounds in this complex NELANT environment. Faster ray models (ASEPS, TASSRAP, FACTEX, etc.) are not recommended, nor are faster noise models (components of ASEPS and TASSRAP, or FANM) except for limited cases (FANM for shallow-water wind noise). If PE/MPP were not available, NUC's Raywave model appears to be the next best choice. It will have considerable difficulty with the NELANT environment and a successful comparison with measured data is considered much higher risk than for PE/MPP.

In the event that MPP is not made available for the Regional Assessment, an alternative to the PE/MPP model would be PE/RAY2D. RAY2D is a range-dependent ray-tracing model developed by Tetra Tech and available through PSI. Developmental efforts similar to PE/MPP would be required, however a PE/RAY2D model would be lower risk in terms of accuracy than Raywave.

D. MODEL AVAILABILITY, STATUS AND REQUIRED DEVELOPMENT

Table III-3 summarizes the status, availability, and required developmental efforts for the models recommended for the assessment. In some instances models may reside at more than one location, and availability is stated assuming that political/proprietary hurdles are removed. An X indicates a completed phase. The ( ) indicate the area requiring a major effort and ✓ indicates subsequent minor efforts required to achieve a ready status. A row of X's and an R under "Mods Reqd" (modifications required) indicates a model is ready. The numbers in the parentheses refer to the following list of required developmental effort.

(1) The PE/MPP combination is awaiting LRAPP funding for an implementation of the formulated approach. Implementation and testing is expected to take six months, however, it could be accelerated to three months if necessary. Since the components have been separately evaluated, evaluation efforts would be minimal.

(2) FANM ships and TASSRAP as well as the general shipping densities (RMS) need incorporation of SQUARE DEAL data (or a defensible rationale for rejecting the data).

Models	Location	Formulated	Developed	Evaluated	Mods Required	Data Selected	Extrapolated	Grid/Extraction	Interfaced	Mods Required
		STATUS								
		Acoustic				Environmental				
Acoustic										
(PE+MPP)	NORDA/SAI	X	(1)	✓	R					
FACT	NORDA et al.	X	X	X	R					
SHALFACT	NORDA	X	X	X	R					
FANM ships	NORDA	X	X	X	(2)					
TASSRAP	NORDA	X	X	X	(2)					
SIAM	NRL	X	X	X	(3)					
DSM	PSI	X	X	X	(4)					
USI/DSM/SAI	USI/PSI/SAI	X	(5)	✓						
Omni - PE	NORDA	X	X	X	(R)					
NRMM	———	(6)	✓	(6)						
Environmental										
Sound Speed										
SQDL Summer	NORDA					X	(7)	✓	X	
Best NRL Summer	NORDA					(8)	✓	✓	✓	
Winter	NORDA					(9)	✓	✓	✓	
Bathymetry	NORDA/[illegible]					X	X	X	✓	(10)
Reflectivity	NORDA					X	(11)	✓	✓	
Wind Speed	NORDA					X	X	X	X	R
Shipping Density	NORDA/PSI					✓	X	X	X	(2)

Key:

X Finished and Ready (R - No Modifications Necessary)

(n) Major Effort Required - See Discussion

✓ Minor Effort Following ( )

Table III-3. Model Availability, Status and Required Development

(3) SIAM must be extended to consider multiple beams of a SASS (if used rather than USI/DSM/SAI).

(4) DSM must be interfaced with a propagation loss routine and a statistical analysis package to be useful for beam-noise modeling.

(5) The USI model must be interfaced with an automatic input routine (e.g., FANM ships). If this is not done it can only be used for selecting cases. The interface between DSM and the SAI model must be developed.

(6) The near-bottom noise model must be formulated, developed and, somehow, evaluated.

(7) The SQUARE DEAL summer baseline sound-speed sections must be projected appropriately and the corresponding extraction routines developed.

(8) Other sections for the rest of NELANT summary must be selected, projected, banked, and CFIELDed.

(9) The summer sections should be winterized, following which extraction, etc. should be straightforward.

(10) SYNBAPS (currently resident at NSRDC) should be interfaced with the propagation loss driver for extraction and filtering of

bottom profiles. If NBNM is developed it may draw heavily on SYNBAPS and a statistical bottom-characteristics driver would be required.

(11) The reflectivity data must be interpreted and extrapolated, then griddled/banked and interfaced with the propagation-loss models.

The above discussion has focused on individual developmental items. Because a substantial amount of data preparation and transfer is required, the processes should be highly automated in the context of a mainframe where environmental data are automatically extracted and model-oriented files written, ready for direct access by the models. This is not a trivial effort. Since a common set of transmission-loss models has been selected consolidation through at least this phase appears possible. If the diverse approaches to noise modeling can be focused on a single model (such as the DSM/SAI model with support from the USI model), a similar consolidation is possible with a direct interface to the transmission-loss predictions.

Since interpretations and displays of the statistics of beam noise will be a new subject for the regional assessment team, a certain amount of trial-and-error analysis and experimentation must be anticipated. A possibility which requires further investigation is to develop at a given location the time series of noise density in very narrow angular bins and in frequency and depth, saving the time series for subsequent insertion of one or more systems at several different headings.

With the exception of the near-bottom distributed systems very little has been said by the system PIs on how they intend to portray the time variability of the field. Computer driven graphical techniques might be quite illuminating and data should be saved at appropriate steps anticipating such a possibility.

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SAI-78-527-WA	Spofford, C. W.	NELANT DATA ASSESSMENT APPENDIX III-MODELING REPORT	Science Applications, Inc.	770225	~~ND~~ ADA 047680	U
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Unavailable	Unavailable	TAP II BEAMFORMING SYSTEM SOFTWARE FINAL REPORT	Bunker-Ramo Corp. Electronic Systems Division	770501	ADC011789	U
S01037C8	Unavailable	TAP 2 PROCESSING SYSTEM FINAL REPORT HARDWARE DOCUMENTATION (U)	Bunker-Ramo Corp. Electronic Systems Division	770501	ADC011790; NS; ND	U
Unavailable	Weinberg, H.	GENERIC FACT	Naval Underwater Systems Center	770601	ADB019907	U
Unavailable	Unavailable	TASSRAP II OB SYSTEM TEST	Analysis and Technology, Inc.	770614	ADA955352	U
Unavailable	Unavailable	LRAPP TECHNICAL SUPPORT	Texas Instruments, Inc.	770624	ND	U
Unavailable	Bessette, R. J., et al.	TASSRAP INPUT MODULE	Analysis and Technology, Inc.	770729	ADA955340	U
Unavailable	Unavailable	TAP-II PHASE II FINAL REPORT	Bunker-Ramo Corp. Electronic Systems Division	770901	ADC011791	U
Unavailable	Unavailable	LONG RANGE ACOUSTIC PROPAGATION PROJECT (LRAPP)	Xonics, Inc.	770930	ADA076269	U
SAI78696WA	Unavailable	REVIEW OF MODELS OF BEAM-NOISE STATISTICS (U)	Science Applications Inc.	771101	NS; ND	U
TRACORT77RV109C	Unavailable	FINAL REPORT FOR CONTRACT N00014-76-C-0066 (U)	Tracor Sciences and Systems	771130	ADC012607; NS; ND	U
Unavailable	Unavailable	LONG RANGE ACOUSTIC PROPAGATION PROJECT (LRAPP)	Xonics, Inc.	771231	ADB041703	U
Unavailable	Homer, C. I.	SUS SOURCE LEVEL ERROR ANALYSIS	Underwater Systems, Inc.	780120	ND	U
Unavailable	Fitzgerald, R. M.	LOW-FREQUENCY LIMITATION OF FACT	Naval Research Laboratory	780131	ADA054371	U
Unavailable	Unavailable	MIDWATER ACOUSTIC MEASUREMENT SYSTEM - PAR AND ACODAC	Texas Instruments, Inc.	780228	ADB039924	U
ORI TR 1245	Moses, E. J.	OPTIONS, REQUIREMENTS, AND RECOMMENDATIONS FOR AN LRAPP ACOUSTIC ARRAY PERFORMANCE MODEL	ORI, Inc.	780331	ND	U
Unavailable	Hosmer, R. F., et al.	COMBINED ACOUSTIC PROPAGATION IN EASTPAC REGION (EXERCISE CAPER): INITIAL ACOUSTIC ANALYSIS	Naval Ocean Systems Center	780601	ADB032496	U
LRAPPRC78023	Watrous, B. A.	LRAPP EXERCISE ENVIRONMENTAL DATA INVENTORY, JUNE 1978 (U)	Naval Ocean R&D Activity	780601	NS; ND	U
TR052085	Solomon, L. P., et al.	HISTORICAL TEMPORAL SHIPPING (U)	Planning Systems Inc.	780628	NS; ND	U